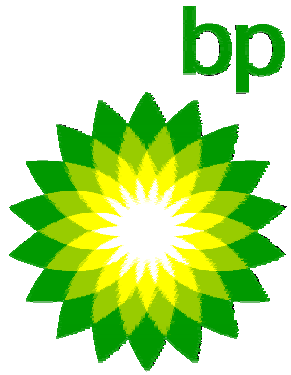


Progress Towards Understanding Risk From Long-Term Storage of CO_2

Tony Espie, May 2003

Outline

- Issues for geologic storage of CO_2
- Framework for understanding risk
- Looking Forward
- Summary

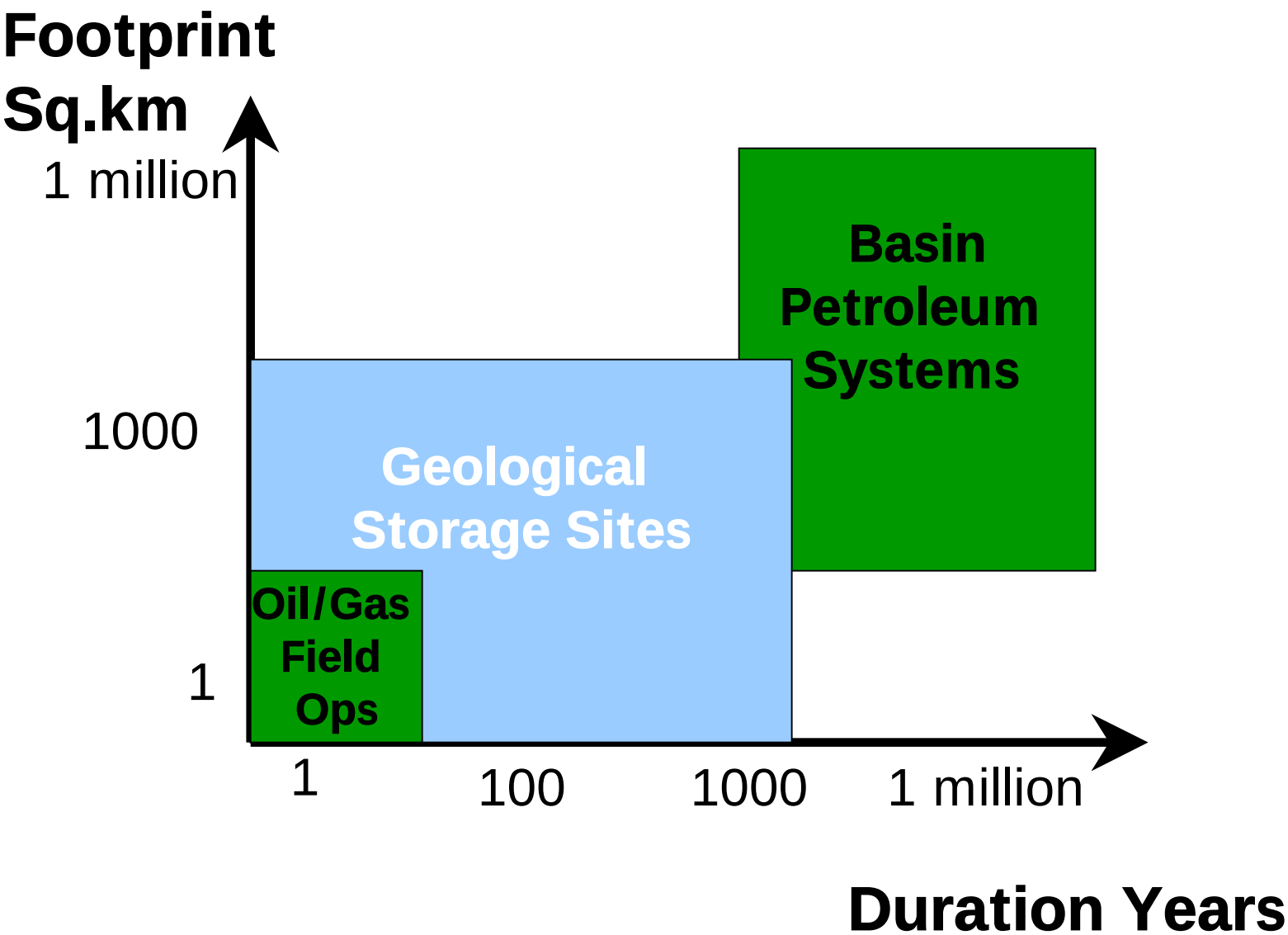
Non-Technical Issues

- Social Acceptance
  - Need for better awareness and informed debate on capture and storage of CO_2
- Regulatory
  - No framework to cover long-term storage of CO_2
  - Conventions covering utilisation of offshore need clarification
- Commercial
  - Eligibility for carbon trading
  - Ownership of stored CO_2

Technical Challenges

- Storage Duration
- Leakage and Release
  - Geological
  - Geochemical
  - Wells
- Impacts and Consequences of Leakage
  - Where, How much, Flux rate?
- Need for Mitigation and management Techniques

Dimensions of Scale



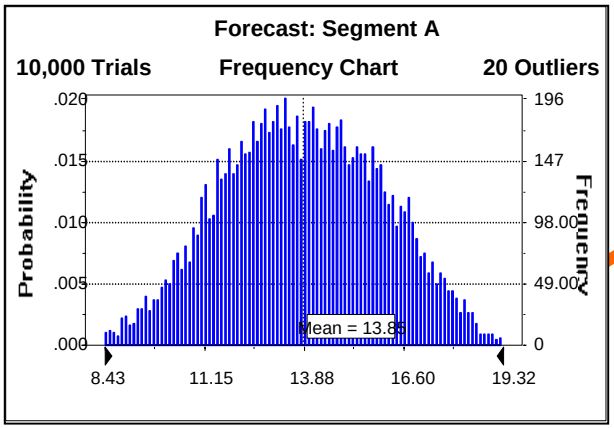
Risk Analysis Process

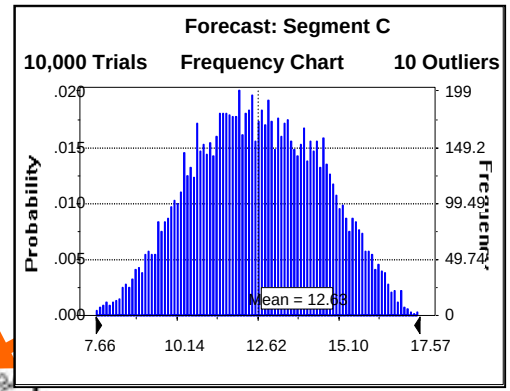
- Identification of risks
  - Create scenarios
- Quantification of risks
- Evaluation
  - Assess risks
  - Develop management process
- Project implementation
- Monitoring and mitigation

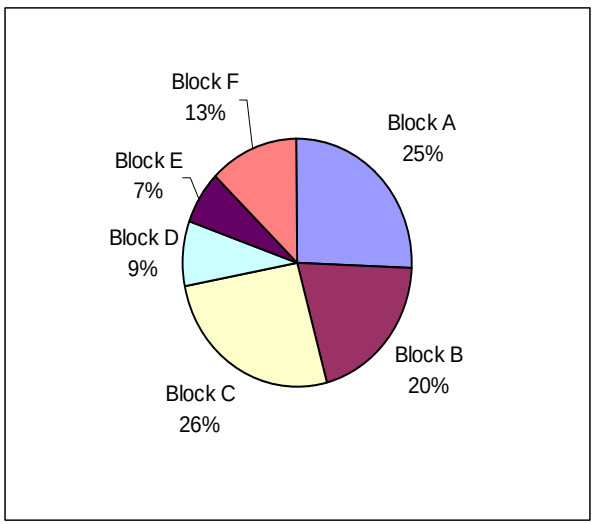
Progress Towards Common Methodology

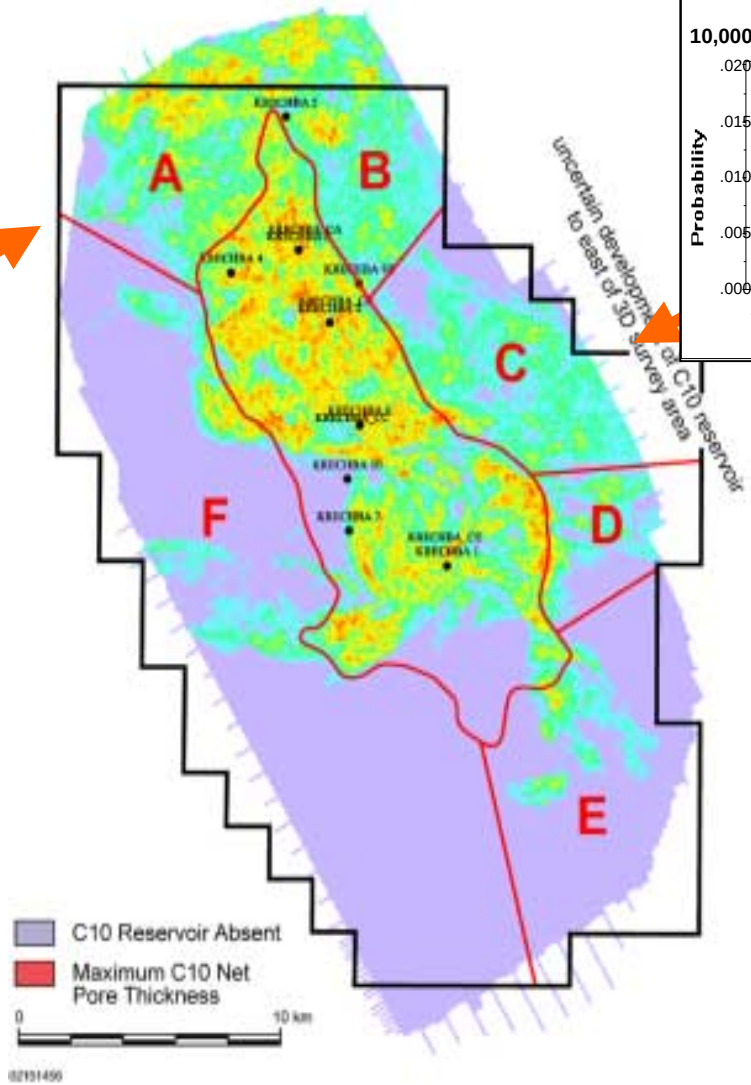
- Identification of risks
  - Number of groups moving towards FEP approach
  - Potential alignment with one generic database hosted on public server
- Quantifying risks
  - Range of different tools being developed and tested
  - No consensus yet on merits and shortcomings of different approaches
- Assessment of risks
  - Agreement on acceptable levels of risk requires stakeholder input
  - Development of regulatory frameworks yet to start

Uncertainty in Storage Capacity





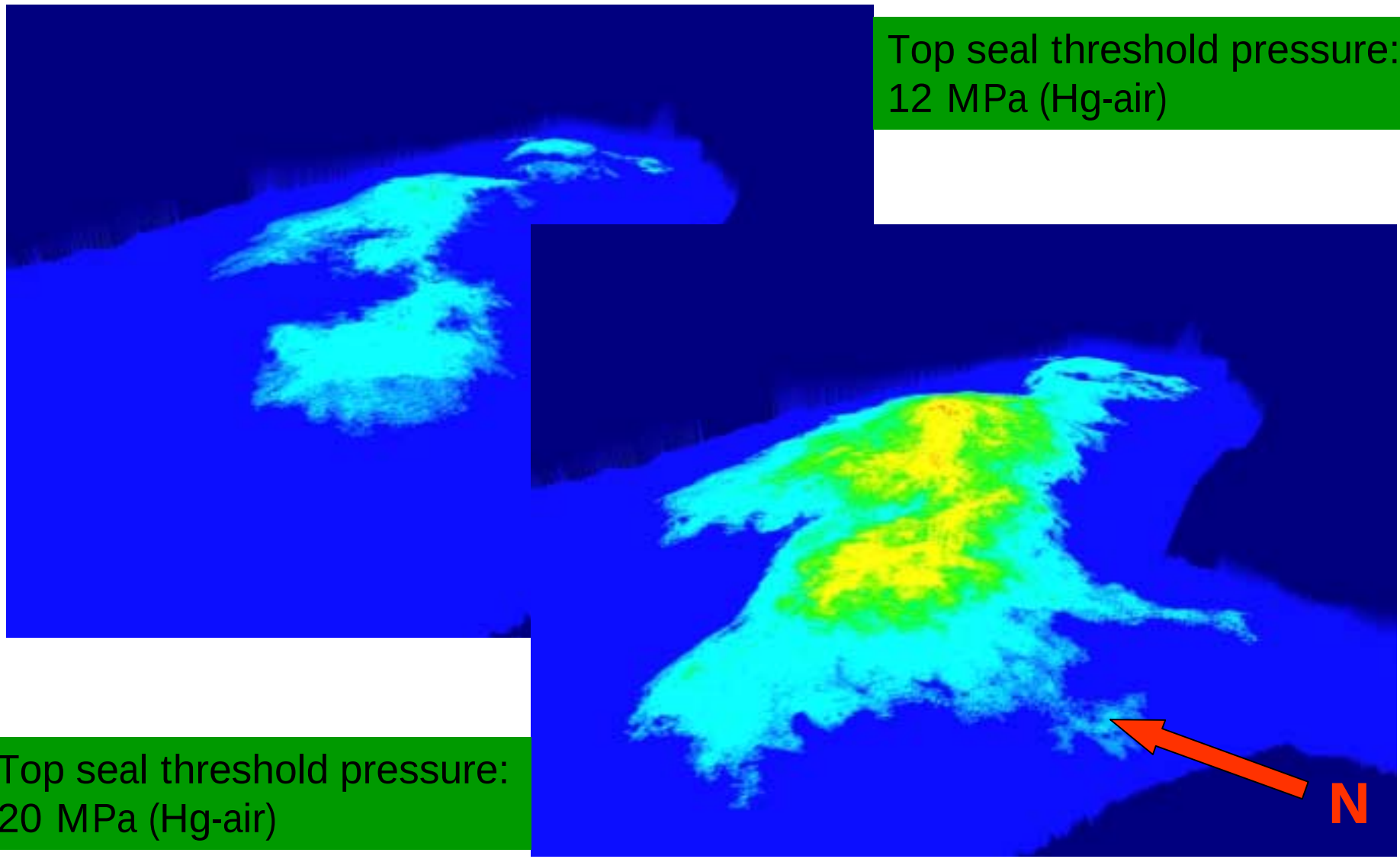




Modelling Tools

- Seal integrity
  - Coupled flow, geochemical and geomechanical simulation models now developing
- Migration
  - Compositional reservoir simulation
  - Basin modelling
  - Invasion Percolation modelling
- Coupling flow systems
  - Wellbore processes are major gap
  - Models being tested for vadose zone and sub-sea/ocean linkage

Invasion Percolation Approach



Validating Model Predictions

- Issues
  - Model predictions need to extend over timescales outside our direct experience
  - Input data may be incomplete leading to greater uncertainty in performance predictions
- Benchmarking of simulators
- Use of analogues
  - Establishing evidence of duration of storage
  - Potential for model system to test predictive capability ?

Next Steps

- Maintain efforts to share information on methodology and data between groups
  - Generic FEP database hosted on IEA GHG server
  - Validation of database
- Development and validation of predictive tools
  - Examine role of natural analogue data for validation
- Stakeholder acceptance
  - Sharing of information and promotion of public dialogue

Summary

- As part of portfolio of options, capture and storage of CO_2 has potential to lead to material reductions in emissions but does raise natural concerns over safety
- Understanding of risk is fundamental to acceptance of this technology
- Established processes are being adapted for CO_2 storage
- Range of tools being tested to quantify physical processes
- Wellbore leakage and stakeholder dialogue are areas where significant action is required